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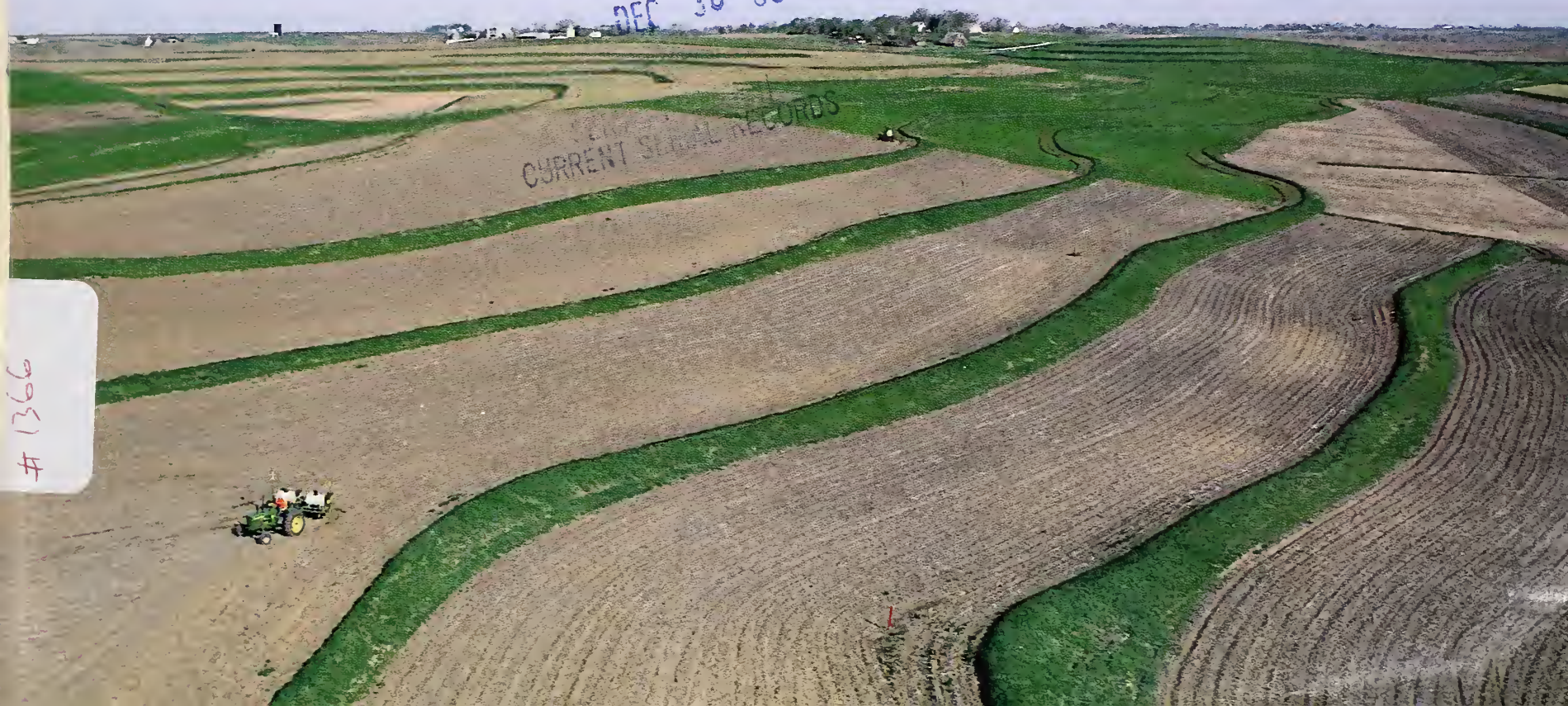
Save Soil Systematically

Resource Management Systems for Midwestern Cropland



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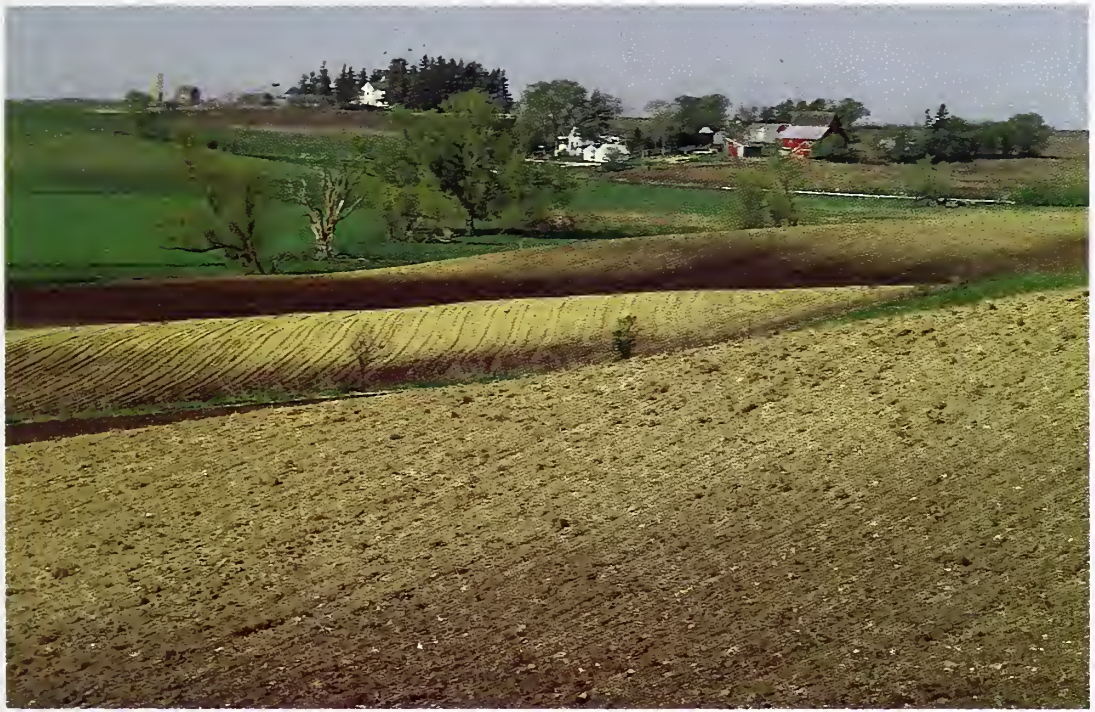
Cover photo: Erosion can be controlled with a resource management system, such as this combination of terraces, conservation tillage, and contour farming.

Save Soil Systematically Resource Management Systems for Midwestern Cropland

The topsoil of much midwestern cropland is eroding at alarming rates. More than 109 million acres of cropland, about 47 percent of the cropland in the region, have inadequate protection against erosion. In 1982, sheet and rill and wind erosion moved about 1.5 billion tons of soil on cropland in the region. That figure doesn't include the soil eroded from the shallow temporary gullies that are farmed across by normal tillage nor does it include the erosion from larger permanent gullies. If the fields of the Midwest are to continue to produce crops to help feed the nation and the world, erosion on those fields must be reduced to a rate that will not damage their long-term productivity.



Erosion occurs when rain falls on unprotected slopes. In time, the fertile topsoil is washed from the higher parts of a field, leaving the lighter-colored, less-fertile subsoil.

Loss of soil productivity is only part of the damage that erosion can cause. Runoff from cropland can carry sediment, fertilizers, and pesticides into waterways to damage the environment and increase the cost of using the water downstream.

The only way to reduce erosion and control runoff to protect soil and water is to make conservation an integral part of your farming operations. The Soil Conservation Service (SCS) can help you design a resource management system that enables you to make productive use of your soil and water resources—and your time and money—without abusing those resources or creating problems for your neighbors or communities downstream or downwind.

What is a Resource Management System?

A resource management system for cropland is a combination of conservation practices and management designed to protect the soil so that you can continue to grow crops economically, while protecting the environment. To achieve this general goal, your system has to include practices that enable you to:

- Remove excess runoff water from fields without causing erosion.
- Reduce erosion so that it does not lower the productive capacity of your soils.
- Manage tillage, planting, and harvesting so that soil tilth, structure, organic-matter content, and permeability rate remain favorable for good plant growth.

Resource management systems protect both cropland and the land and water downstream. A grassed waterway removes runoff from this field safely. Rock riprap protects the streambank and channel bottom at the waterway outlet.

Conservation practices in a well-planned system help to achieve multiple goals. This field windbreak provides protection against wind erosion and provides food for wildlife.

- Apply all pesticides and other chemicals according to the manufacturer's label so that you get satisfactory results and do not cause offsite pollution.
- Apply fertilizers and other soil amendments at recommended rates.
- Control application of irrigation water to use water more effectively and minimize loss of soil, water, and nutrients.

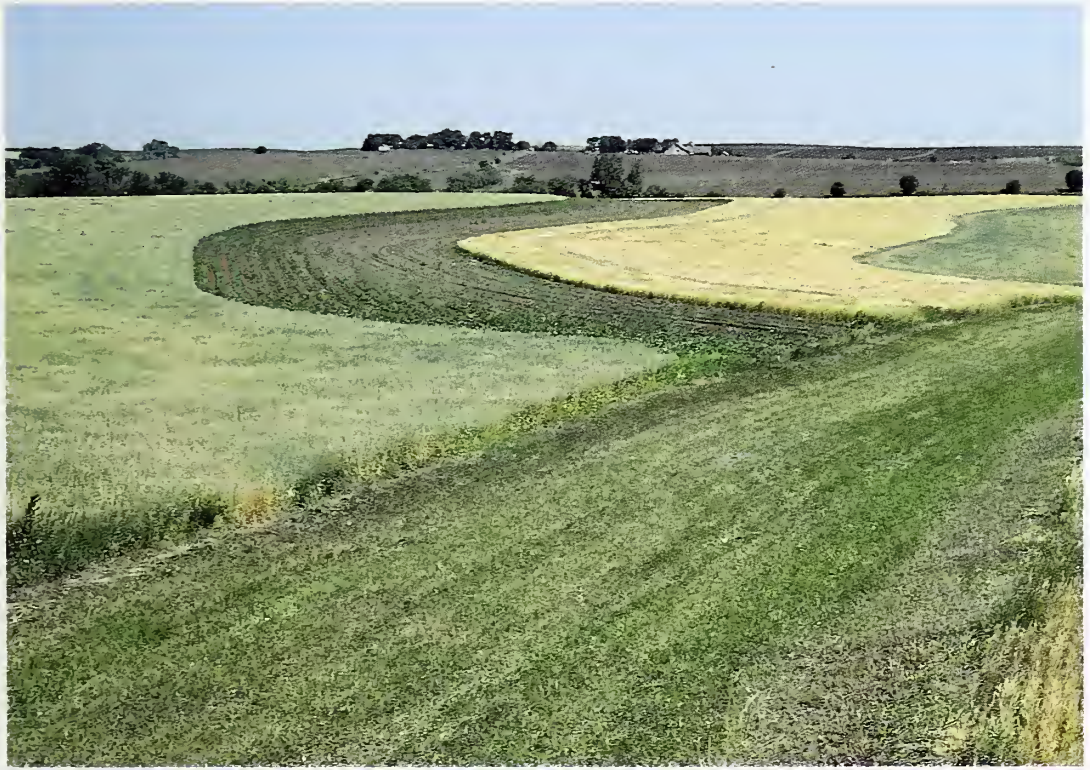
Your management system might also include practices that would enhance the quality of the environment and increase your income. For example, it might include drainage ditches or subsurface drains in wet soils, or measures to improve irrigation water management in soils suitable for irrigation, or measures to improve wildlife habitat. It would probably include fertilizing and liming for optimum production.

Combining Practices to Make a System

You generally need more than one conservation practice to solve a specific resource problem. For example, if your main goal is to reduce erosion by water to a rate that will not damage either the long-term productivity of your fields or the quality of the rest of the environment, you will probably have to use several practices. If your field has long slopes, neither contouring nor conservation tillage alone will provide adequate protection against severe storms; the two practices together may control sheet and rill erosion even when storms are severe. But neither of these practices can provide protection against concentrated flow, so you'll also need grassed waterways to prevent gully erosion where runoff concentrates. In some fields, you'll need still other practices to make the erosion control practices work more effectively. If there are poorly drained spots in the field where you plan to use conservation tillage for erosion control, you may also need tile drains to maintain yields in those spots and to permit field operations at the same time as the rest of the field.

A resource management system for your cropland is more than a combination of practices to solve one resource problem, however. It is a plan designed to make productive use of your soil and water resources, considering the whole range of conditions and possible problems you face. In addition to reducing erosion by water, you might also need to protect your soils against wind. You might need to ensure that you'll be able to make maximum use of moisture in drier-than-average years. You might need to prevent pollution of a nearby stream or of ground water or want to preserve wildlife habitat or recreation opportunities on your land. You can meet all of your objectives

On long slopes or irregular slopes, runoff concentrates in natural drainageways and may cut a gully, even in fields protected by conservation tillage.



To adequately manage excess runoff, grassed waterways or underground outlets are needed in addition to practices like conservation tillage and contour stripcropping.

for adequately protecting your soil and water, if you plan and follow a system.

Your system should be planned to fit your individual circumstances and needs. Your system has to maintain your soil and water resources under conditions in your area, considering the size of your operation, the equipment you own, and your financial situation. Soil Conservation Service technicians have tools such as the Universal Soil Loss Equation and Wind Erosion Equation and procedures to estimate gully erosion to help you compare various systems. They can estimate results of various combinations of crops and management for your climate and soils and can estimate the relative costs of alternative conservation treatments.

Major Practices

A resource management system may be simple, or it may be complex, containing many individual practices, each a vital part of the working system. Your system will include some of the practices shown on the following pages. In addition, it might include other conservation practices such as diversions, water-and-sediment-control basins, drainage systems, cover crops, windbreaks, grassed filter strips, integrated pest management, or permanent vegetation on critical areas.

Resource management systems include practices to prevent damage onsite and off-site. Here, terraces reduce erosion in the field. Grassed filter strips and wooded areas along the stream prevent water pollution and provide wildlife habitat.

Conservation Tillage

Conservation tillage leaves crop residue on the surface to reduce erosion, maintain or improve soil tilth, increase infiltration, reduce evaporation, and reduce the amount of sediment reaching surface water. It is defined by SCS as any tillage and planting system that maintains residue on at least 30 percent of the surface after planting to reduce soil erosion by water, or, where soil erosion by wind is the main concern, maintains at least 1,000 pounds of flat small-grain residue equivalent on the surface during the critical erosion period.

In the most commonly used forms of conservation tillage, a chisel, sweep type implement, or disk is used over the whole area of the field. The disk has already replaced the moldboard plow as the most-used tillage implement in some areas.

Conservation tillage isn't defined by the implement used, however, but by the results achieved. Disks and chisels bury 30 to 70 percent of the residue on each trip across the field, depending on the type of disk used, depth at which it is set, and speed of operation. If you make more than one pass over the field with large, concave, widely spaced disks set to till deep, you aren't using conservation tillage.

Other forms of conservation tillage, such as strip-till, ridge-till, and no-till, disturb only part of the surface. These systems provide more protection than methods that disturb the whole surface, and they cost less to use.

No-till is the most effective form of conservation tillage for controlling erosion. In no-till, no more than 10 percent of the surface is disturbed. A narrow slot opened to place the seed

Disking is effective only if enough residue is left on the surface.

at the right depth is the only tillage. Weeds are controlled with chemicals. In areas suited to no-till, you can expect no-till to produce yields equal to or higher than those for conventional tillage. No-till may be less successful on fine-textured, poorly drained soils. Researchers are conducting studies to identify soils that are suitable for no-till and to develop new techniques and equipment for soils where current no-till methods aren't fully successful.

In strip-till, narrow strips are tilled at planting time. In ridge-till, seed is planted in the ridges that were formed during cultivation of the preceding crop. The ridge planter has small disks or flat sweeps that move 1 to 2 inches of soil and residue from the ridges into the furrows. Ridge-till is a very good method in wet areas because the ridges dry out and warm up earlier than level fields. On sloping

Crop residue left in the field through the winter increases soil moisture by trapping snow.

Ridge-till, which leaves residue between the rows, can be used on cold,wet soils where other types of conservation tillage are less satisfactory.

fields, however, you should use these methods on the contour because, if the ridges or tilled strips run up and down the slope, erosion could still be severe in the unprotected seedbed.

Another form of conservation tillage, stubble mulching, is used in areas where rainfall is low and wind erosion is a problem. You use equipment that cuts below the surface so that residue is left on the surface. This equipment allows you to control weeds while maintaining enough surface residue to control erosion. Stubble mulch can work without the aid of chemical herbicides.

All forms of conservation tillage provide a number of benefits:

Conservation tillage reduces soil erosion 50 to 90 percent compared to conventional tillage. Just how much reduction you achieve will

depend on which form of conservation tillage you use, the type of erosion that could occur, how susceptible to erosion your fields are, and whether you use other conservation practices in combination with conservation tillage.

Conservation tillage increases infiltration of water and conserves moisture. This increased moisture in the soil can increase yields.

Conservation tillage reduces the amount of sediment that reaches our streams and lakes.

Conservation tillage may give you an advantage when unfavorable weather in spring reduces planting time. Since conservation tillage requires fewer trips across the field than conventional tillage does, you can wait for favorable conditions and plant a much larger area in the time that is available.

These Canada geese are feeding in a no-till cornfield. The crop residue left on the surface in conservation tillage provides food and cover for many species of wildlife.

Soil Conservation Service conservationists can provide information and help farmers use conservation tillage successfully.

Conservation tillage saves fuel.

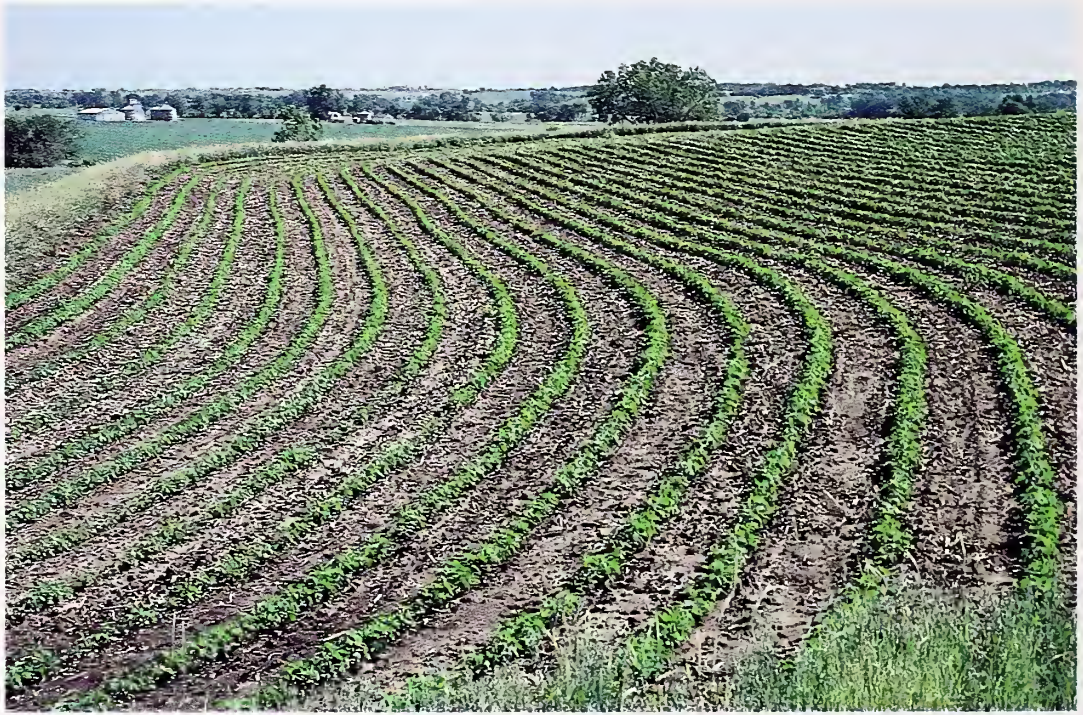
Conservation tillage reduces costs of repair and replacement of equipment, since you're using the equipment less. You also need less equipment.

One point that you have to remember, however, is that conservation tillage is not a simple technique. You need to use careful management based on sound information to make conservation tillage effective. You need to adjust or modify your equipment as well as the amounts and types of fertilizers and other chemicals you apply and the time and methods for applying them. The timing and sequence of field operations are more critical than with conventional tillage. You may need to plant different varieties because the growing environment is different. And you will continue to have to adjust, because precipitation and temperature vary from year to year, and pest populations and diseases follow natural cycles.

Contouring

Tilling and planting on the contour are very effective in reducing erosion in many circumstances. Contouring is most effective on short, gentle slopes.

Erosion occurs where turnrows are planted up and down slopes.



A system provides complete protection for this field. Terraces divide the field into shorter slopes. Contouring and conservation tillage help to prevent soil movement. Grass borders protect the edges of the field.

It can provide adequate protection against erosion from storms of moderate to low intensity. It doesn't provide complete protection against severe storms that cause more runoff than the contour furrows can hold. It doesn't provide complete protection if part of the field is not contoured. Erosion on field edges can be severe if you till the turnland up and down the slope. You may need to include grassed borders as part of a complete resource management system.

Conservation tillage and contouring together can be very effective in some fields. For example, in a typical midwestern field with continuous corn on a moderately erodible soil with long slopes, SCS estimates the average annual sheet and rill erosion would be 40 tons per acre if the field were tilled up and down the slope using conventional tillage. If conservation tillage were the only conservation practice used on this field, annual erosion would be 15 tons per acre. If only contouring were used, average annual erosion would be 20 tons per acre. If both conservation tillage and contouring were used, average annual erosion would be a little less than 8 tons per acre. That's much less than it would be with either practice alone, but it's still more than the 5 tons per acre that soil scientists set as the average maximum safe rate for most soils. And erosion at those rates could cause serious damage to water and land downstream. A resource management system to adequately protect this field would have to include not just conservation tillage and contouring but also some other practice, such as a crop rotation to increase the surface cover or terraces to shorten the slopes. Grassed waterways or underground outlets would be needed to remove runoff safely.

Crop Rotations

Rotations, especially those that include perennial grasses or perennial legumes, reduce the average erosion rate for the rotation period. Rotations also help to maintain or improve the physical condition of the soil and to control weeds, insects, and disease. If you rely mainly on chemical pesticides, you may still need to use rotations to minimize problems of herbicide carryover or the appearance of pesticide-resistant species. Legumes in a rotation may reduce the need for commercial fertilizer because the legumes may provide nitrogen for the following crop.

Stripcropping

Contour stripcropping and field stripcropping reduce erosion by water. In contour stripcropping, you alternate contoured strips of close-grown crops with strips of row crops. The width of the strips is based on the steepness and length of your slopes and can be adjusted to the size of your equipment. Generally, if you contour stripcropped with a rotation of 3 years of corn, 1 year of wheat and 4 years of alfalfa on that typical field, the average annual rate of sheet and rill erosion should be under 5 tons per acre. You could add other practices to bring the erosion rate even lower if you had other goals to consider. If the field were just above a reservoir that was rapidly filling with sediment, for example, the erosion rate might have to be reduced below the rate that would be safe if only long-term soil productivity were considered.

Systems and individual practices have to be designed for the specific conditions and problems. Contour stripcropping protects sloping fields in the Cornbelt from water erosion. Wind stripcropping protects fields in the eastern Great Plains against wind erosion.

In wind stripcropping, the strips are uniform in width, straight, and laid out as nearly as possible at a right angle to the prevailing winds. Stripcropping is often used in wheat-fallow rotations in the Great Plains. The strips that hold soil in the summer also catch snow in winter and hold it on the field to increase soil moisture and crop yields.

Terraces

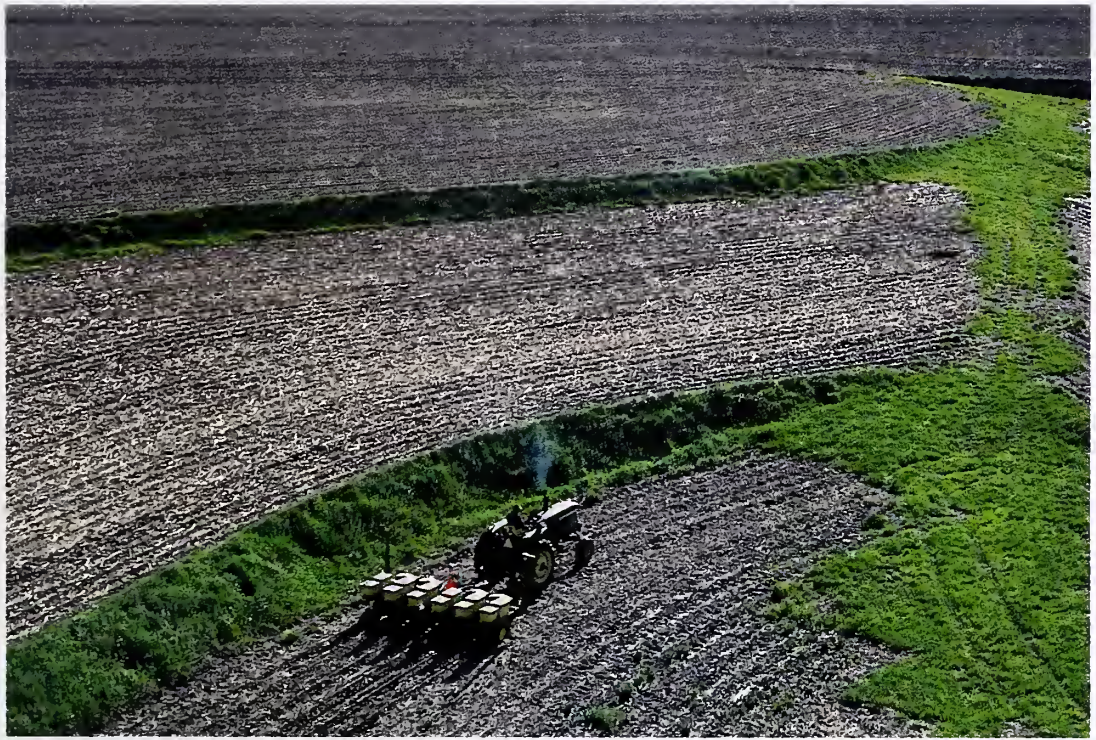
A terrace is an earth embankment, a channel, or a combination of ridge and channel constructed across the slope. Terraces are used to control water erosion and to conserve water. They can also be used to improve water quality and prevent off-site damage caused by sediment and runoff. Terraces designed for erosion control conduct the water to a stable outlet at a safe velocity. Flat channel terraces designed for water conservation impound the water so that it can soak into the soil.

A terrace system is designed to be compatible with your equipment and methods. To determine how far apart to space your terraces, you have to consider the steepness of your slopes, the characteristics of rainfall in your area, the erodibility of your soils, the crops you plan to grow, and the other conservation practices in your resource management system. The spacing can be adjusted slightly to improve alignment of the terraces, to fit the topography better, or to match your equipment. You want terraces at the widest spacing consistent with erosion control. If you use contouring and conservation tillage on your terraced land, the spacing can be wider than would be safe if you used conventional tillage. Also, since less soil will move into the terrace channel, less maintenance will be needed.

On that typical midwestern cornfield, parallel terraces could be designed to reduce average annual sheet and rill erosion to just over 13 tons per acre. Using conservation tillage on the terraced land would reduce erosion to about 5 tons per acre.

There are three types of terraces—broadbase, narrowbase, and steep backslope. To decide which would be best for you, you have to consider the steepness of your slopes, the relative costs of constructing and farming the terraces,

These flat channel terraces impound water and increase crop yields.



Relatively steep slopes can be cultivated without causing excessive erosion if steep backslope terraces and conservation tillage are used.

and the ease of farming them. Broadbase terraces are used on gentle slopes. Narrowbase and steep backslope terraces can be used on steeper slopes. The entire area of broadbase terraces is farmed, so they do not reduce the acreage of productive land. Farming some slopes may be more hazardous and difficult after the terraces are constructed, however, because the terrace slopes are steeper than the original slope. The backslope of steep backslope terraces and both slopes of narrowbase terraces are taken out of crop production and kept in permanent grass. Steep backslope and narrowbase terraces are less expensive to build than broadbase terraces. Narrowbase terraces are easy to farm because you don't operate machinery on the ridge and, if you use underground outlets, the intake pipes are near the ridge so that farming around them isn't difficult.

Assistance from SCS

The Soil Conservation Service helps individuals, groups, and units of government conserve soil and water resources on their land. SCS conservationists work directly with farmers in helping them develop resource management plans for their farms. They are also available for followup assistance to fine-tune management and make adjustments needed in the plan or in specific practices.

Individuals get help from SCS mainly through local conservation districts. Under state law, each conservation district is responsible for soil and water conservation work within its boundaries. Locally elected district boards plan long-range programs to meet the needs of their district. SCS provides technical assistance to the district and its cooperators.

SCS and the districts work closely with local units of other federal agencies and with state and local groups to plan and carry out the most effective program possible.

The Soil Conservation Service provides assistance to farmers in planning safe and productive use of their soil and water resources.

All programs and services of USDA are available to everyone without regard to race, creed, color, sex, age, handicap, or national origin.